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CORRESPONDENCE

Pv-aCO_2 and Pv-aCO_2/Ca-vO_2 in shock resuscitation: physiologically appealing, but challenging in resource-limited ICUs

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We read with interest the ESICM 2025 guidelines on circulatory shock and hemodynamic monitoring by Monnet et al. [1]. The integrative framework combining macrohemodynamics and tissue perfusion markers is valuable. We would like to comment on the statement that, in patients with both a central venous and an arterial catheter, serial measurements of the veno-arterial carbon dioxide difference (Pv-aCO_2) and related indices should be performed to guide resuscitation.

The physiologic rationale for Pv-aCO_2 and Pv-aCO_2/Ca-vO_2 as flow-related and anaerobic metabolism markers is compelling. However, when these indices have been used as resuscitation targets in randomized controlled trials, improvement in patient-centered outcomes has not been demonstrated. In the multicenter trial by Su et al., 228 patients with severe sepsis or septic shock were randomized to a strategy targeting Pv-aCO_2/Ca-vO_2 or ScvO_2 [2]. Although the intervention arm more frequently achieved the physiologic target, 28-day mortality did not differ (24.0 vs 29.6%; $p=0.35$).

In the Lactel randomized study, 179 patients with acute circulatory failure and arterial lactate ≥ 3 mmol/L were assigned to an algorithm based on CO_2–O_2-derived indices or to standard care [3]. The primary endpoint, lactate clearance > 10% at 2 h, was achieved in 50.0% of control patients and 43.8% of intervention patients ($p=0.497$), and 28-day mortality remained similar (44.9 vs 33.3%; $p=0.150$). Taken together, these trials failed to show a clinical benefit of Pv-aCO_2- or Pv-aCO_2/Ca-vO_2-guided resuscitation.

By contrast, simple bedside indices of peripheral perfusion such as capillary refill time (CRT) have suggested potential benefits. In the ANDROMEDA-SHOCK trial, a CRT-targeted strategy, compared with lactate-targeted resuscitation, resulted in numerically lower 28-day mortality (34.9 vs 43.4%; $p=0.06$) and better early organ dysfunction trajectories [4]. CRT and other measures of skin perfusion can be assessed at almost no cost and without additional laboratory resources.

This is especially relevant in low- and middle-income countries with limited ICU budgets. Each determination of Pv-aCO_2 or Pv-aCO_2/Ca-vO_2 requires at least one arterial and one central venous blood gas, often repeated serially, plus hemoglobin measurement. Where even a single arterial blood gas can consume a large share of a patient's daily laboratory budget, routine Pv-aCO_2-based monitoring risks diverting resources from other proven interventions.

Pv-aCO_2 and Pv-aCO_2/Ca-vO_2 also require cautious interpretation and are influenced by several metabolic and microcirculatory factors [1]. From the standpoint of a resource-constrained ICU, the absence of demonstrated outcome benefit in randomized trials, combined with the cost and logistical burden of repeated dual blood gas sampling, makes broad, systematic use of these indices difficult to justify. In our view, Pv-aCO_2-based variables are best considered as adjuncts in selected complex cases, whereas bedside assessment of peripheral perfusion together with lactate kinetics offers complementary,

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low-cost information with trial-level support for guiding resuscitation [4].

We hope that this perspective will help clinicians, especially in low- and middle-income settings, to contextualize and adapt the guideline recommendations according to local feasibility, costs, and outcome data, while preserving the physiologic framework proposed by the ESICM panel.

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